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o. 102. Issued May 20, 1908.

nited States Department of Agriculture,
BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

THE ASPARAGUS BEETLES.[a]

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INTRODUCTORY.

Asparagus was introduced into this country with the early settlers from Europe, and is credited with having been cultivated here for two hundred years before being troubled with insects.

Several species of native American insects have been observed to feed upon this plant, but none, so far as we know, has become sufficiently attached to it to cause serious injury. Few of our edible plants, in short, down to the time of the civil war have enjoyed such immunity from the ravages of insects.

In the Old World two insects, called asparagus beetles, have been known as enemies of the asparagus since early times. In the year 1862 one of these insects, the common asparagus beetle (*Crioceris asparagi* L.) was the occasion of considerable alarm on asparagus farms in Queens County, N. Y., where it threatened to destroy this, one of the most valuable crops grown on Long Island. Subsequent

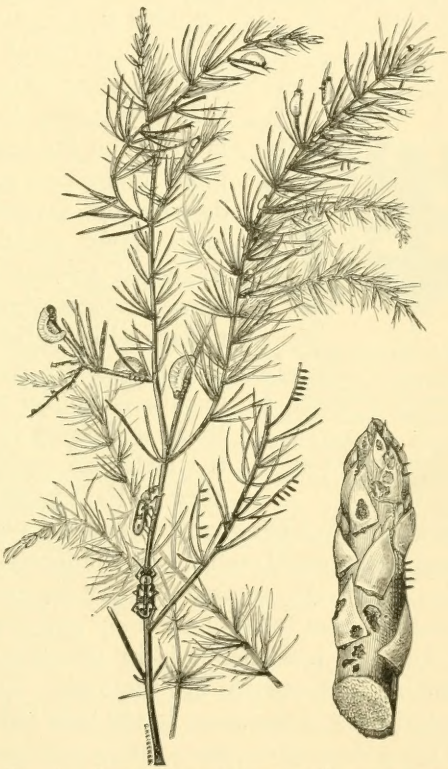

FIG. 1.—Spray of asparagus, with common asparagus beetle in its different stages; asparagus tip at right, showing eggs and injury. Natural size (author's illustration).

[a] Other accounts of these insects have been published in earlier years, as follows: Yearbook U. S. Dept. Agric. f. 1896 (1897), pp. 341–352; Bul. 10, Div. Ent., U. S. Dept. Agric., pp. 54–59, 1898; Bul. 66, Pt. I, Bur. Ent., U. S. Dept. Agric., pp. 5–10, 1907.

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inquiry developed the fact that the species had begun its destructive work at Astoria, near New York City, in 1860, where, it is now conceded, it was introduced about 1856.[a]

In 1881 another European importation was detected on asparagus near Baltimore, Md.—the twelve-spotted asparagus beetle (*Crioceris duodecimpunctata* L.), sometimes called the "red" asparagus beetle to distinguish it from the "blue" species.

THE COMMON ASPARAGUS BEETLE.

(*Crioceris asparagi* L.)

From the seat of its introduction at Astoria, N. Y., the common asparagus beetle soon spread to the asparagus farms of Queens County, N. Y., and by 1862 was reported to have occasioned the loss of over a third of the crops in certain localities, the loss being estimated at $50,000.

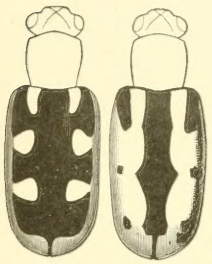

FIG. 2.—Common asparagus beetle (*Crioceris asparagi*): *a*, Dark form of beetle; *b*, light form. Enlarged (author's illustration).

Injury is due to the work of both adults and larvæ upon the tender shoots, which they render unfit for market early in the season. Later they destroy by defoliation the high-grown plants, particularly seedlings, the roots of which are weakened by having their tops devoured. The larvæ are sometimes so abundant that the black molasses-like fluid which they emit from their mouths soils the hands of those engaged in bunching the stalks for market; and the eggs are sometimes laid upon the stalks in such numbers that the latter are rendered unsightly and even slippery by their presence. Larvæ, as well as beetles, attack the tenderest portions of the plants, but the beetles gnaw with seemingly equal relish the epidermis, or rind, of the stems. The beetles are also accused of gnawing young shoots beneath the surface, causing them to become woody and crooked in growth.

In some localities it is in establishing new beds that the greatest trouble and expense are incurred. The plants must grow a year as seedlings and two more in the beds before being cut for table use, and during these three years they are constantly exposed to the attacks of this insect.

The beetle is a beautiful creature, slender and graceful in form, blue-black in color, with red thorax, and with lemon-yellow and

[a] The capture of this species was recorded early in the past century in Pennsylvania—presumably near Hanover—and again in the vicinity of Chicago and Rock Island, Ill., about ten years after the discovery on Long Island; but, as the insect did not obtain a permanent foothold, but died out in these localities, these importations can not be considered introductions.

dark-blue wing covers having a reddish border. A common form about the District of Columbia is illustrated in fig. 3, *a*. Farther north the prevailing form is darker, the lighter coloring sometimes showing only as a reddish border and six small submarginal yellow spots (fig. 2, *a*). An extreme, light form not uncommon in the southern range of the insect is shown (fig. 2, *b*) for comparison. The length is a trifle less than one-fourth inch.

HISTORY OF SPREAD.

From the scene of its first colonization in Queens County, the insect migrated to the other truck-growing portions of Long Island. It soon reached southern Connecticut, and has now extended its range northward through that State and Massachusetts to the State line of New Hampshire. Southward it has traveled through New Jersey, where it was first noticed in 1868, eastern Pennsylvania, Delaware, and Maryland to southern Virginia and North Carolina.

Its distribution by natural means has been mainly by the flight of the beetles. Undoubtedly, also, the beetles have been transported from place to place by water, both up and down stream by rising and falling tide, as the fact that it has not until recently deviated far from the immediate neighborhood of the seacoast and of large water courses near the coast bears abundant testimony.

Another reason for the prevalence of this species in these localities is that asparagus was originally a maritime plant and has escaped from cultivation and grown most luxuriantly in the vicinity of bodies of water. It is well known that it is usually upon wild plants that these insects first make their appearance in new localities. There is evidence also that their dissemination may be effected by what Doctor Howard has termed a "commercial jump," either by commerce in propagating roots, among which the insects may be present either as hibernating beetles or as pupæ, or by the accidental carriage of the beetles on railroad trains or boats.

By some such artificial means the asparagus beetle had found its way to northwestern New York, between Rome and Buffalo, and to Ohio, between Cleveland and the Pennsylvania State line. During 1896 its course was traced along the Hudson River above Albany. Inquiry concerning the Ohio occurrence disclosed the fact that the plants in one locality were brought from New York. The presence of this insect in eastern Massachusetts at about the same time was in like manner probably due to direct shipments of roots from infested localities to Boston and vicinity.

It is noticeable that up to this time its inland spread, except in the neighborhood of water, had been extremely limited.

DISTRIBUTION IN 1908.

This species is present now in what is known as the Upper Austral life zone, although in certain points in New England it has located in what is considered the Transition zone. Its course up the Hudson River lies within a rather narrow strip of Upper Austral. In all probability it is destined in time to overspread the entire Upper Austral zone and to make its way to some extent into neighboring areas in which it may find conditions for its continuance.

Its distribution in Massachusetts, though wide, is local. In New Hampshire it has been recorded from Nashua and Portsmouth. It is possible that in a few years it may be able to encroach slightly upon the bordering States of Vermont, in the vicinity of the Connecticut River Valley, and Maine, near the New Hampshire seaboard. It is well established in Connecticut, occurs in Rhode Island, and is generally distributed through New Jersey, Delaware, and Maryland, and in southeastern Pennsylvania near the Delaware River. It was predicted by the writer that, although this species in 1896 was still local in New York and Ohio, we might expect within a few years to hear of its invading other portions of those States lying within the Upper Austral zone; Canada, of which there is a strip of Upper Austral bordering the northern shore of Lake Erie; and, later, Indiana, Illinois, Kentucky, and States farther west. By 1897 the species had occupied the strip bordering the southern shore of Lake Erie, being recorded from nine counties of eastern Ohio. The following year it was noticed in western Virginia. In 1898 it was reported from Benton Harbor, Mich., where, however, it had been present since 1896. By 1899 it had appeared in Canada in the Niagara River region and was accompanied by the twelve-spotted species. The insect obviously received more or less severe setbacks in succeeding years, but by 1904 the common form was observed about Toronto, Canada, and about 4 miles west of Chicago, Ill. It has now become very generally distributed in the asparagus-growing sections of New York State, having reached Glens Falls, its northernmost recorded limit in the United States. In Ohio the species has been established near Columbus since 1903, and near Cincinnati since 1905, but has not been reported from Kentucky or Indiana, although it has probably invaded the latter State.

In 1904 the occurrence of this insect at Bouldin Island, California, was reported, but the following year it could not be found. Its disappearance was attributed to the fact that the island had been flooded, causing the death of the pest. In 1906, however, the beetle was reported in abundance near Oakley, Cal.

In North Carolina the species is well established in the east-central part, including portions of Wake, Wayne, Warsaw, and Duplin coun-

ties. The species has also been reported in Wisconsin, but nothing has been learned regarding its actual distribution in that State.

HABITS AND LIFE HISTORY.

The common asparagus beetle passes the winter in the adult state under convenient shelter, such as piles of rubbish, sticks, or stones, or under the loose bark of trees and fence posts. Toward the end of April or in May, according to locality, at about the season for

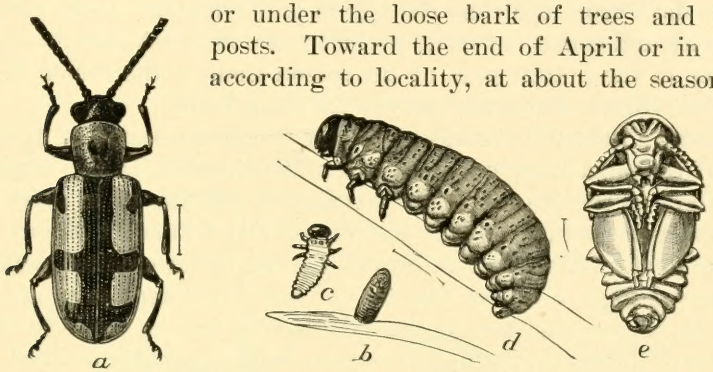

FIG. 3.—Common asparagus beetle (*Crioceris asparagi*): *a*, Beetle; *b*, egg; *c*, newly hatched larva; *d*, full-grown larva; *e*, pupa. All enlarged (author's illustration).

cutting the asparagus for market, the beetles issue from their hibernating quarters and lay the eggs for the first brood.

The egg is very large in proportion to the beetle, being nearly a sixteenth of an inch in length, and of the elongate-oval form illustrated at *b* (fig. 3). It is nearly three times as long as wide and of a dark-brown color. The eggs are deposited endwise upon the stem or foliage and in early spring on the developing stalks, usually in rows of 2 to 7 or more (fig. 4).

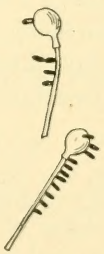

FIG. 4.—Eggs of common asparagus beetle (*Crioceris asparagi*) on asparagus buds. Somewhat enlarged (original).

In from three to eight days the eggs hatch, the young larvæ, commonly called "grubs" or "worms," presenting the appearance indicated in fig. 3, *c*. The head of the newly hatched larva is large, black, and bead-like; its body is gray; and its three pairs of legs, black. It at once begins to feed, and is from ten days to a fortnight, according to Fitch and others, in attaining full size. When full grown the larva appears as in fig. 3, *d*. It is soft and fleshy, much wrinkled, and of a dark gray or olive color, sometimes light, but not infrequently very dark. The head is shining black, as are also the six legs. Each segment is provided with a pair of foot-like tubercles, which, with the anal proleg, assist it in crawling and in clinging to the plant. The mature larva enters the earth, and here, within a little rounded, dirt-covered cocoon which it forms, the pupa state is

assumed. The pupa is yellowish in color, and its appearance is sufficiently shown by the illustration (fig. 3, *e*). In five to eight or more days the adult beetle is produced, which in due time issues from the ground.

THE LIFE CYCLE.

Of the duration of the life cycle Fitch has remarked that it is about thirty days from the time the egg is laid until the insect grows to maturity and comes out in its perfect form, but that the time will be shorter in the hottest part of the season than in the cooler days of May and June. These periods are for Long Island.

During a hot spell in midsummer the minimum period of ovulation and of the pupa stage was observed at Washington, D. C. Eggs that were laid on the 5th of August hatched on the 8th, or in three days. A larva transformed to pupa on August 4 and to adult August 9, or in five days. Allowing ten days as the minimum credited period of the larval stage, a day or two for the larva to enter the ground and form its cocoon, and two or three days more for the beetle to mature and leave the earth, the insect is again ready to attack its food plant and to continue the reproduction of its kind in about three weeks from the time that the egg is laid.

This may be fairly taken to represent the minimum midsummer life-cycle period of the species in the District of Columbia and southward. In the colder climate of New England, and elsewhere in spring and autumn weather, the development from egg to beetle will require from four to perhaps seven weeks. The hibernating beetles appear in the latitude of the District of Columbia as early as April, and beetles of a later brood have been observed in abundance in October as far north as northern Connecticut. In its northern range two and perhaps three broods are usually produced, and farther south there is a possibility of four or five generations each year.

NATURAL CHECKS.

The common asparagus beetle has very efficient natural checks in the shape of predaceous insects of many kinds, which prey upon its larvæ and assist very materially in preventing its increase. One of the most efficient of these is the spotted ladybird, *Megilla maculata* DeG. The beetle is rose-colored, with numerous black spots. The convergent ladybird (*Hippodamia convergens* Guer.), the spined soldier-bug (*Podisus maculiventris* Say), and the bordered soldier-bug (*Stiretrus anchorago* Fab., fig. 5) are also active destroyers of asparagus beetle larvæ, which they attack and kill by impaling them upon their long proboscides and sucking out their juices. Certain species of wasps and small dragon-flies also prey upon the asparagus beetle grubs. Two of the most abundant of

these are *Polistes pallipes* Lep. and *Ischnura* (*Nehalennia*) *posita* Hagen. These insects hover about the infested plants until a larva is descried, when they pounce upon it and carry it away.

Asparagus beetles are very susceptible to sudden changes of temperature, and it has been frequently noticed by Mr. C. W. Prescott, of Concord, Mass., that immense numbers of the hibernating beetles are killed in winter during severely cold spells following "open" weather, millions of their dead bodies being sometimes found under bark and in other hiding places.

The intense heat that prevailed at times during the summer of 1896, especially during the first two weeks of August, though conducive to the undue propagation of some forms of insects, had the opposite effect upon certain species that feed in the larval condition freely exposed upon the plants. In the vicinity of the District of Columbia this was particularly noticeable in the case of the larvæ of this aspara-

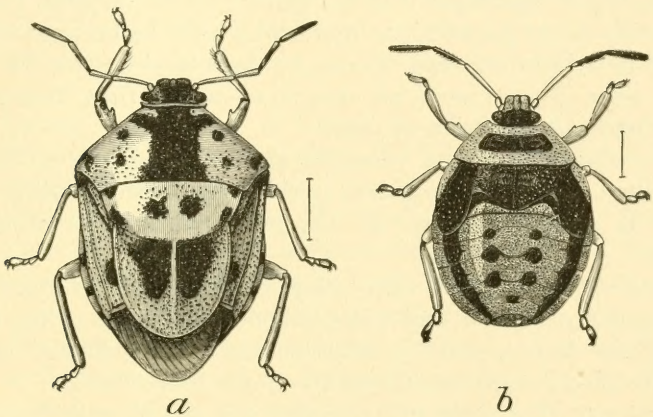

FIG. 5.—Bordered soldier-bug (*Stiretrus anchorago*): *a*, Adult bug; *b*, last stage of nymph. Both enlarged (author's illustration).

gus beetle. Its eggs also seemed to be dried up by the heat. What with the decimation caused by their natural enemies and the heat, scarcely a beetle or larva was to be found that year after the last of August.

REMEDIES.

Fortunately, the common asparagus beetle is not difficult of control, and ordinarily may be held in restraint by the simplest means.

Hand-picking is of value in small beds but must of necessity give way to more approved methods for the vast numbers of the beetles that concentrate their forces upon the large areas devoted to this crop in the suburbs of our large cities.

Chickens and ducks are efficient destroyers of asparagus beetles, and as they do no injury to the plant their services are still in requisition for this purpose at the present day.

Cultural practices.—A practice in high favor among prominent asparagus growers is to cut down all plants, including seedlings and volunteer growth, in early spring, so as to force the parent beetles to deposit their eggs upon new shoots, which are then cut every few days before the eggs have time to hatch for the first new brood.

Other measures that have been employed with advantage consist in cutting down the seed stems after the crop has been harvested, and again once or twice during the cutting season, or in permitting a portion of the shoots to grow and serve as lures for the beetles. Here these may be killed with insecticides, or the plants, after they become covered with eggs, may be cut down and burned, and other shoots allowed to grow up as decoys. The trap plants should be destroyed as often as once a week.

With concerted action on the part of growers in following out any of these last methods the insects may be held in check, at least in a region where asparagus does not grow wild in too great profusion. Where this is not practicable, insecticides must be brought into service. It is well in any case to employ insecticides after the cutting season, since if the insects are destroyed at this time their numbers will be lessened for the next year.

Lime.—One of the best remedies against the larvæ is fresh, air-slaked lime, dusted on the plants in the early morning while the dew is on. It quickly destroys all the grubs with which it comes in contact.

Pyrethrum is credited with being useful, and a mixture of soft soap, quassia decoction, and water (about equal parts of the first two to 5 of the last named) is effective against the larvæ; but these remedies hardly commend themselves for extensive use.

Arsenicals.—The arsenicals, applied dry mixed with flour, as for potato beetles, answer well; they possess the advantage of destroying beetles as well as grubs, and are of value upon plants that are not being cut for food. Some use a mixture of Paris green and air-slaked lime, or plaster, 2 pounds of the former to a barrel of the latter. To produce satisfactory results the lime or arsenical must be applied at frequent intervals, or as often as the larvæ reappear on the beds.

Arsenate of lead has given excellent results. This insecticide has come into very general use in recent years for the control of leaf-feeding beetles, such as the potato beetles and asparagus beetles. In Connecticut Dr. W. E. Britton tested it on asparagus, spraying the plants from all four sides in succession because of the slight leaf exposure as compared with most other forms of plants. Good results followed. The same amount of benefit should be accomplished with scarcely greater expense by spraying from opposite sides and repeating this

before the beetles of the last generation develop or at least in time to destroy them before they get into winter quarters. In Pennsylvania Prof. H. A. Surface made a comparative test of the value of Paris green and arsenate of lead, learning that not more than 50 per cent of the insects were killed when Paris green and lime were used, while 90 per cent were killed with arsenate of lead. In a third experiment, in which resin soap was added to make the latter insecticide adhere more closely to the plants, all of the insects were killed on 50 plants treated. In this case the arsenate of lead was used at the rate of 1 pound to 24 gallons of water, and 2½ pounds of resin soap was added to render the mixture more adhesive.

In the North, where these experiments were made, they were begun the first of June. Arsenate of lead has been used with satisfactory results on asparagus at the rate of 1 pound in 16 gallons of water, but some additional experiments are necessary to ascertain the exact amount of the poison that can be used economically to produce the required result. In ordinary weather a second spraying of arsenate of lead with a resin soap added is desirable, especially if rainfall intervenes.

More specific information in regard to the method of preparing and applying arsenate of lead is given in Circular No. 87, which may be obtained gratis on application.

Everything considered, injury by this species is most noticeable when the beetles are working on the asparagus tips at the time they are being cut for food or market, as more fully described on page 2. It is, of course, impossible to apply arsenicals to the edible product owing to the danger of poisoning human beings. About all that can be done at this time is to cut as frequently as possible, but after the cutting season is over the arsenicals may be freely used in accordance with the directions already given.

The brushing method.—A simple and inexpensive method of killing the larvæ in hot weather is to beat or brush them from the plants with a stick so that they will drop to the bare ground. The larvæ are delicate creatures, and, as they crawl very slowly, few are able to regain shelter of the plants, but die when exposed to the heated earth. The same method is in use against the pea aphis.

THE TWELVE-SPOTTED ASPARAGUS BEETLE.

(*Crioceris duodecimpunctata* L.)

A rarer, and consequently less injurious species than the preceding is the twelve-spotted asparagus beetle. It is generally distributed in Europe, where it is apparently native and, although common, not especially destructive. Like the preceding, it lives exclusively on asparagus, and the chief damage it does is due to the

depredations of the hibernated beetles in early spring upon the young and edible asparagus shoots. Later generations attack the foliage, living, for at least a considerable portion of the larval stage, within the ripening berries.

INTRODUCTION AND SPREAD IN THE UNITED STATES.

The presence of this insect in America, as has been stated, was first discovered in 1881, and in the vicinity of Baltimore, Md. This beetle was noticed in considerable numbers from the first, showing that it had probably been introduced several years earlier. At that time it was quite local, occurring only at the mouth of the Furnace Branch of the Patapsco River at a point a few miles south of Baltimore. It was then seen only on volunteer asparagus growing on the salty margin of this river, although beds of cultivated asparagus were plentiful in the immediate vicinity. Two years later it had proved even more troublesome than the common asparagus beetle.

Assuming Baltimore to have been the original center of distribution, the twelve-spotted asparagus beetle has been traced southward through Anne Arundel and Prince George counties to the District of Columbia, where it was detected five years from the time of its first discovery.

In 1892 it was reported to have appeared in considerable numbers on asparagus stalks that had been cut down upon a farm in Carroll County, Md. The same year its appearance was announced in Gloucester County, in southern New Jersey, and the following year in Cumberland and Camden counties of the same State. To have reached these points the insect, obviously, had traversed the intervening territory in Maryland, the northern half of Delaware, and Salem County, N. J. It was also found to have reached Virginia, near Washington. In 1894 it had extended northward to Burlington County, N. J., and westward to Philadelphia County, in Pennsylvania. The same year it was detected in Queen Anne County, Md., and near Rochester, N. Y. Two years later it established itself in Charles County, Md., and had penetrated as far south in Virginia as Westmoreland County.

In May, 1896, a serious invasion was reported in Prince George County, Md., where the beetles attacked the young shoots, gnawing off the heads as soon as they showed above ground, thus entirely unfitting the crop for market.

Nearly every year since, it has been reported in new localities in the United States and Canada until now it is well distributed westward and northward. In 1898 it had become generally distributed in New Jersey "south of the shale from the Atlantic coast to the Delaware." Next year it was recorded in twelve counties in New York as far west

as Buffalo and in the following years generally throughout New York State, as also in the Niagara district in Canada.

An interesting fact in the occurrence of the asparagus beetles in the Niagara peninsula was that the two species arrived almost simultaneously and that the twelve-spotted form was the dominant one. By 1902 the latter had appeared in Connecticut, at New Haven, and later in other portions of that State.

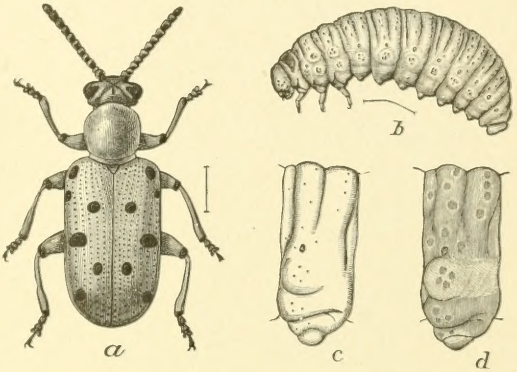

FIG. 6.—Twelve-spotted asparagus beetle (*Crioceris duodecimpunctata*): *a*, Beetle; *b*, larva; *c*, second abdominal segment of larva; *d*, same of *C. asparagi*. *a*, *b*, Enlarged; *c*, *d*, more enlarged. (Author's illustration.)

DESCRIPTION, LIFE HISTORY, AND HABITS.

The mature beetle rivals the common species in beauty, but may be distinguished by its much broader elytra and orange-red color. Each wing cover is marked with six black dots, and the knees and a portion of the under surface of the thorax are also marked with black (fig. 6, *a*). The beetle, as it occurs on the plant when in fruit, very closely resembles at a little distance the ripening asparagus berry.

The common asparagus beetle, as is well known, dodges around a stem like a squirrel when disturbed, but the twelve-spotted form appears to trust to flight, taking wing more readily. Both species make a loud creaking sound when handled, by what is called stridulation, produced in the present species by rubbing the tip of the abdomen against the elytra.

FIG. 7.—*Crioceris duodecimpunctata:* Egg, natural size, on asparagus leaves at right; same, enlarged, at left. (Author's illustration.)

The full-grown larva is shown at *b* (fig. 6). It measures, when extended, three-tenths of an inch (8 mm.), being of about the same proportions as the larva of the common species, but is readily separable by its orange color. The ground color is light yellowish cream with an overlay of ochraceous orange which is most pronounced on the exterior portions of the abdominal segments. The head, with the exception of the mouth-parts, is also ochraceous, the thoracic plate is prominent, divided into two parts, and is of a dark-brown color. Enlarged figures of the second abdominal segment of both species are presented at *c* and *d* (fig. 6) for comparison.

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In Europe, where this species is native, it is common, but not especially destructive.

The chief damage is from the work of the hibernated beetles in early spring upon the young and edible asparagus shoots. Later beetles as well as larvæ appear to feed exclusively on the berries. The eggs are deposited singly, and apparently by preference, upon old plants, toward the ends of shoots, which, lower down, bear ripening berries, and they are attached along their sides (fig. 7), instead of at one end as with the common species. Soon after the larva hatches it finds its way to an asparagus berry, enters it, and feeds upon the pulp. In due time it leaves this first berry for another one, and when full growth is attained it deserts its last larval habitation and enters the earth, where it transforms to pupa and afterwards to the beetle. The life cycle does not differ materially from that of the common species, and there is probably the same number of generations developed, or nearly as many.

REMEDIES.

The remedies are those indicated for the common asparagus beetle, with the possible exception of caustic lime and some other measures that are directed solely against the larvæ of that species, but the habit of the larva of living within the berry places it for that period beyond the reach of insecticides. The collection and destruction of the asparagus berries before ripening might be a solution of the problem, but it is questionable if recourse to this measure would be necessary, save in case of an exceptional abundance of the insect.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *April 15, 1908.*

[Cir. 102]

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